Safe and reliable navigation of vessels in ocean, coasts and harbor areas based on GNSS and its augmentation systems

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rough sea

Source: Internet

foggy weather

Source: Internet

darkness

Source: Internet

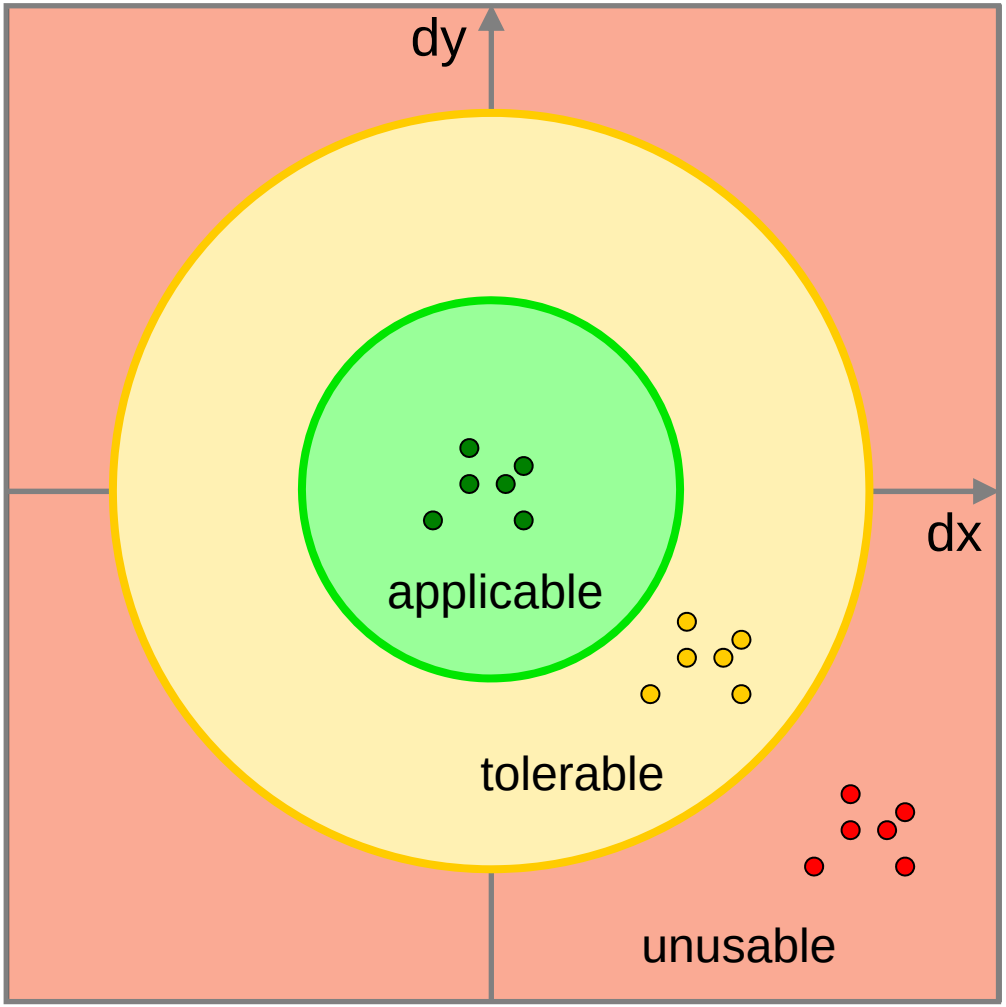
Challenge



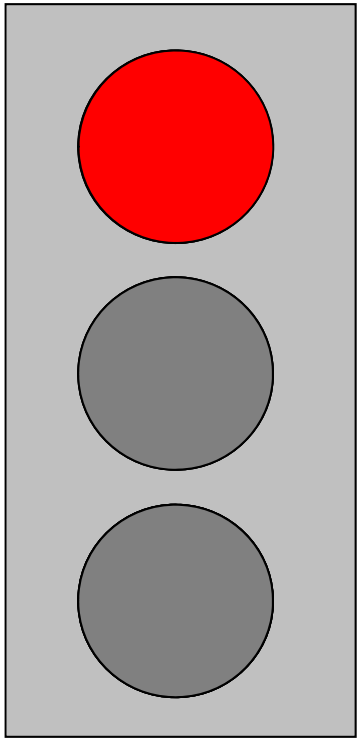
We want to know where we are and we want to know if we **can trust** the information we get !

We have to find a way to obtain **reliable** information !

Accuracy vs. Preciseness



Horizontal Positioning Error



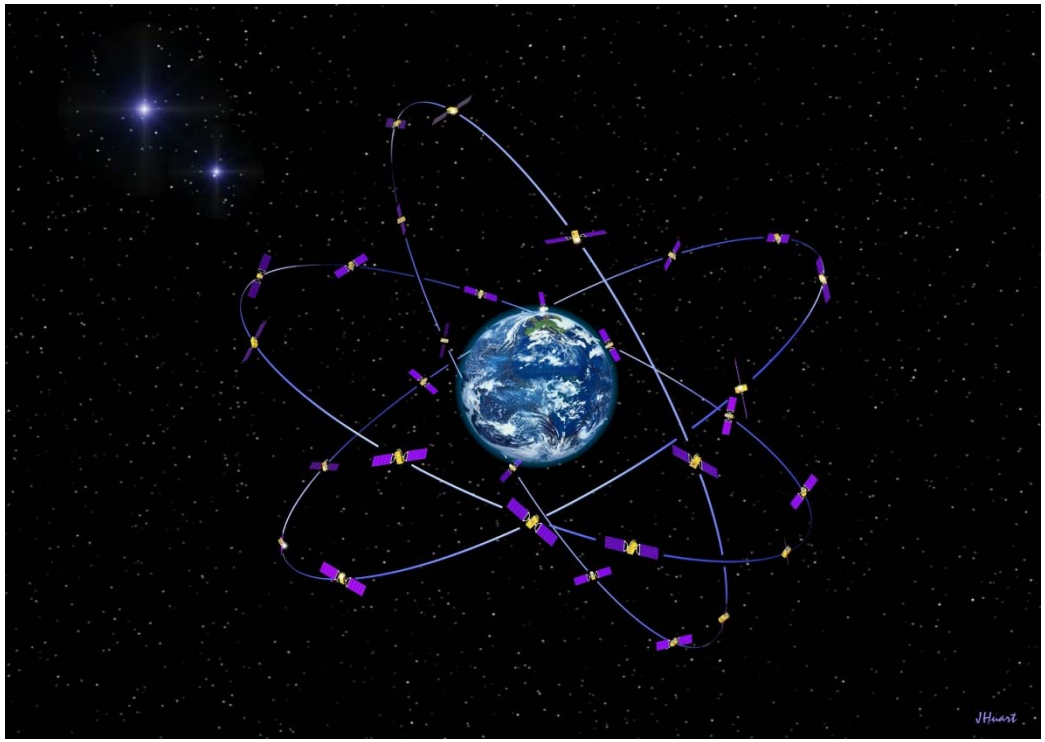
Graphical Translation
for the user or operator

GNSS

A **G**lobal **N**avigation **S**atellite **S**ystem is a system of satellites that provides autonomous geo-spatial positioning with global coverage on earth.

It allow receivers/users to determine their location and time using signals transmitted along a line-of-sight by radio channels from satellites.

The Status Quo in GNSS



GPS (USA)
FOC since1993

GLONASS (Russia)
FOC since1996

GALILEO (Europe)
in development

COMPASS (China)
in development

Achievable horizontal positioning accuracy is around 5 up to 10 m

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IMO A.915(22) Minimum Requirements on future GNSS

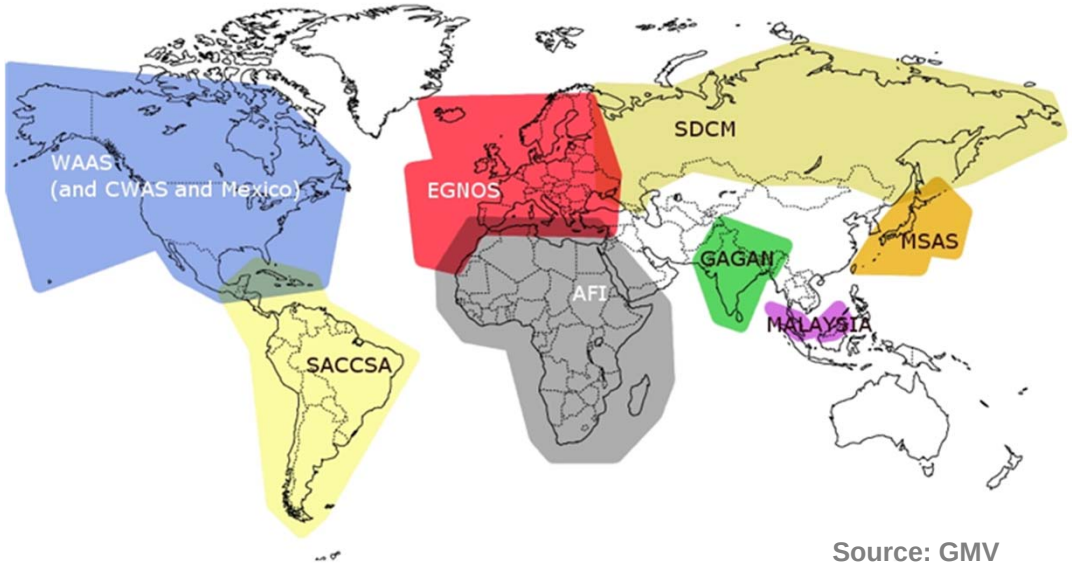
	Absolute Accuracy	Integrity
	Horizontal (m)	Alert Limit (m)
Port	**1**	**2,5**
Automatic Docking	**0,1**	**0,25**

SBAS (DGNSS)

A **S**atellite **B**ased **A**ugmentation **S**ystem is a system that supports wide-area or regional augmentation through the use of additional satellite-broadcast messages.

Ground stations are used to measure the satellite signals and environmental factors which may impact the signals received by the users.

The Status Quo in SBAS (DGNSS)



Source: GMV

WAAS (USA)
operational since 2003
MSAS (Japan)
operational since 2007
EGNOS (Europe)
operational since 2009

GAGAN (India), SDCM (Russia), SNAS (China),
in development

SACCSA (South America), AFI (Africa), Malaysia
feasibility studies

Achievable horizontal positioning accuracy is between 0.5 and 3 m (partly with integrity)

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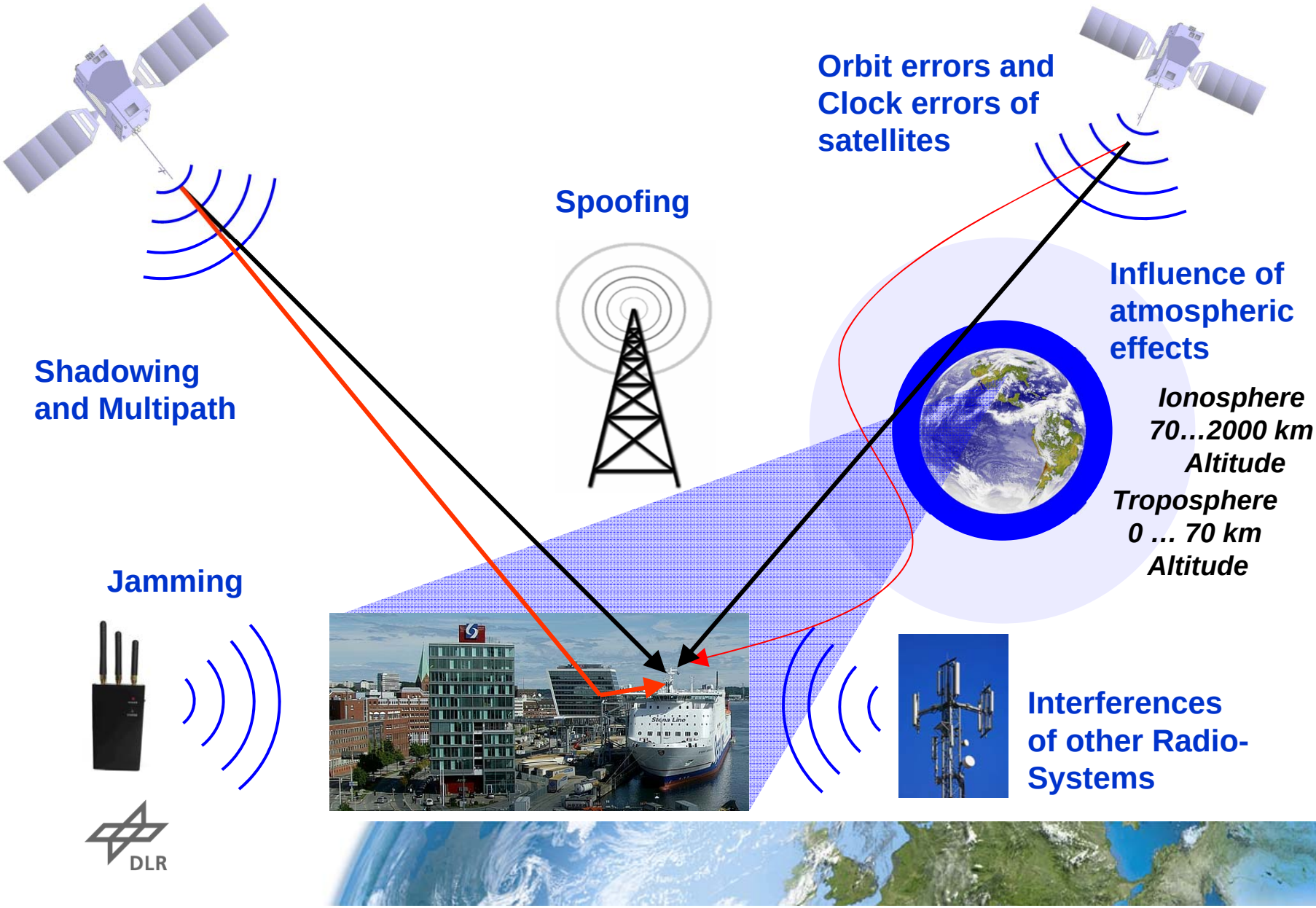
GNSS Error Sources

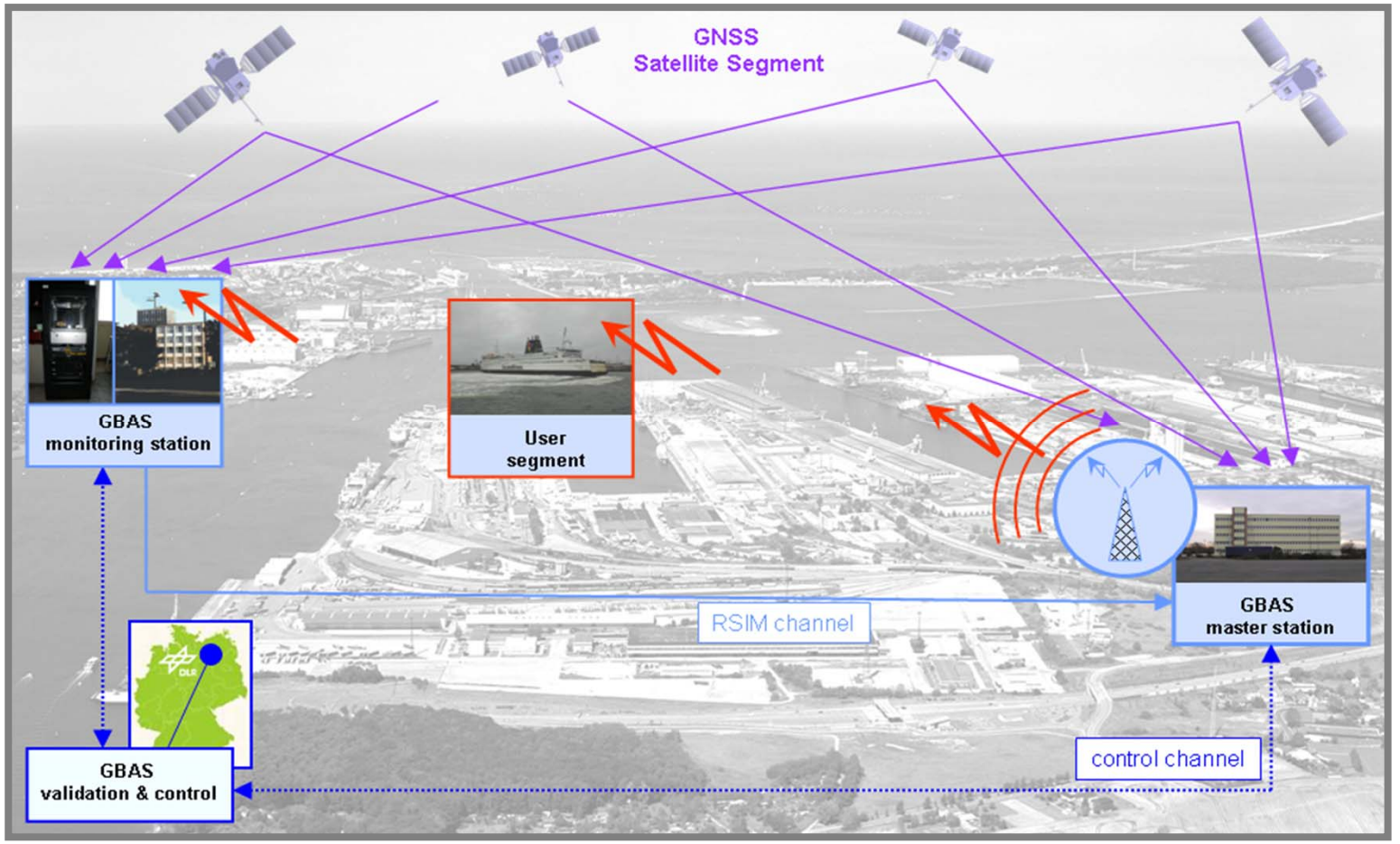


GBAS (DGNSS)

A **G**round **B**ased **A**ugmentation **S**ystem is a system that supports small-scale or local augmentation through the use of additional terrestrial-broadcast messages.

One or more ground stations are used to measure the satellite signals and local environmental factors which may impact the signals received by the users.

An example for a GBAS (DGNSS)



Source: DLR

Achievable horizontal positioning accuracy is in a range of dm up to cm (with integrity)

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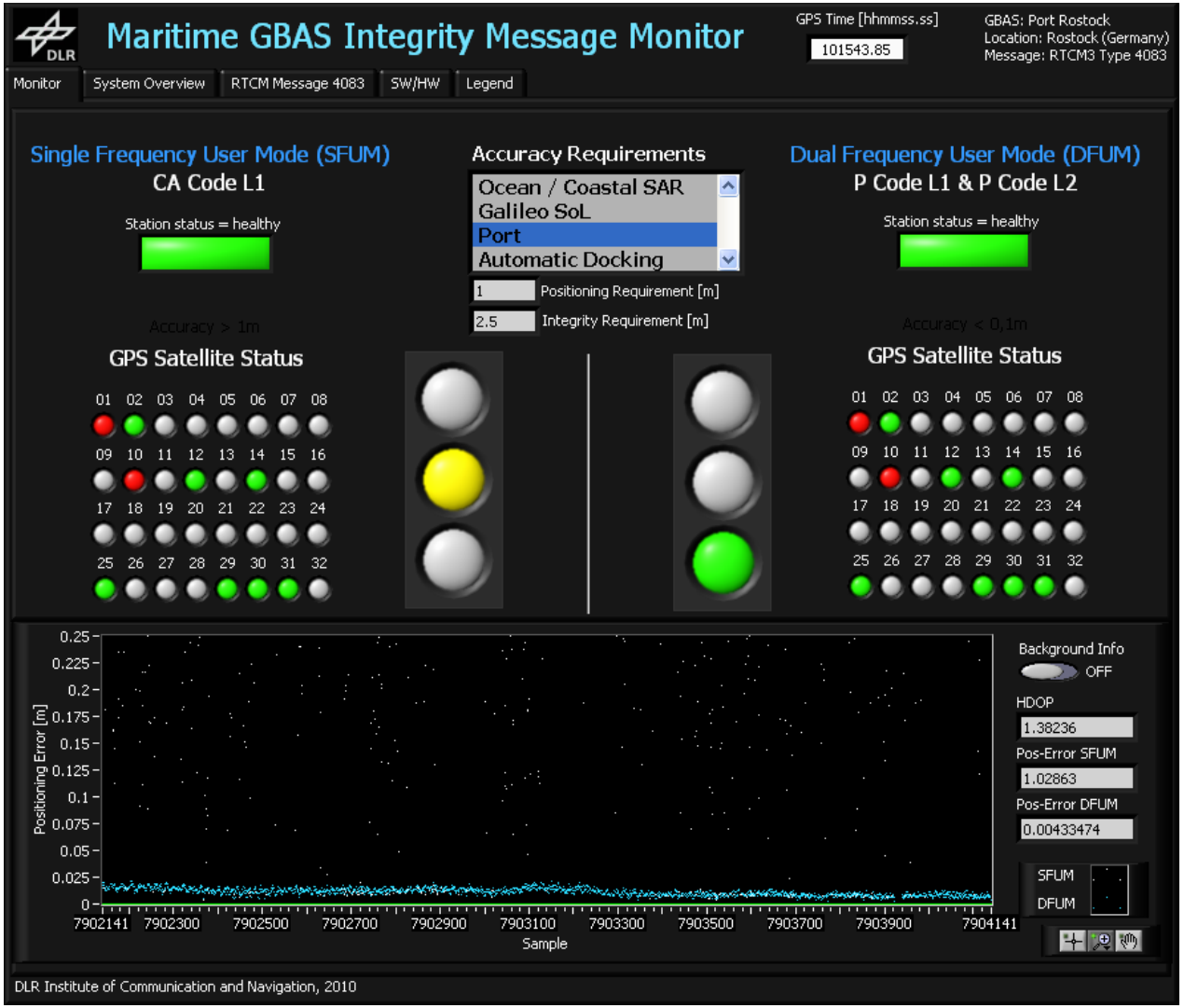
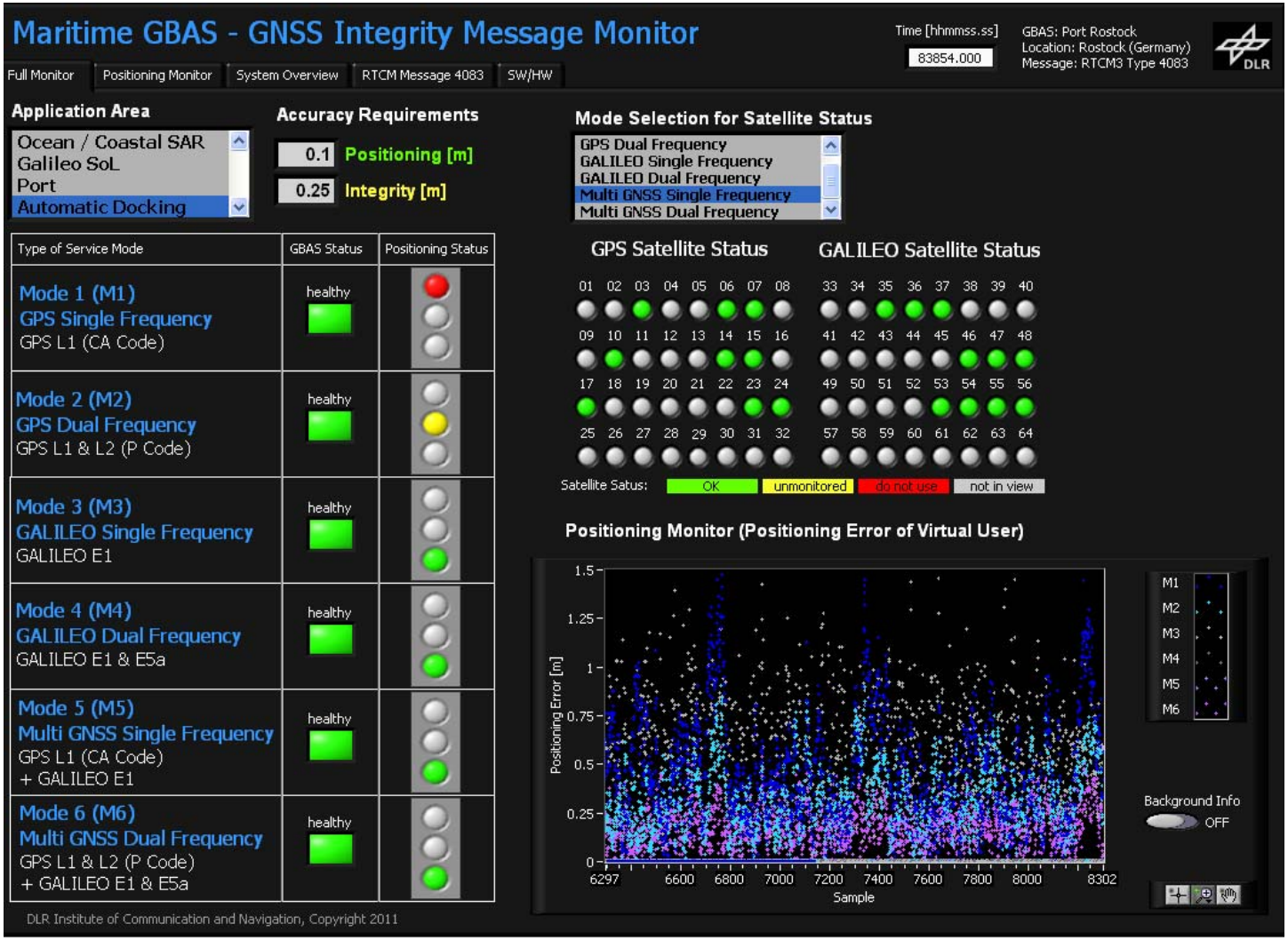
GBAS Integrity Monitor for GPS



Source: DLR

GBAS Integrity Monitor for GNSS



Source: DLR

Embedding of solutions into an international framework

E-Navigation (E-NAV) Strategy of the IMO

- Framework and working program bringing harmony and interoperability into maritime information systems to enhance safety and operations

- Utilisation of all electronic means to integrate these information into ship navigation systems and vessel management systems

- PNT Working work of IALA E-NAV is authorized to propose standardized solutions to fulfil these requirements

Key issues addressed by E-NAV related to GNSS

Detection of malfunctions in core elements of navigation

Provision of support information (e.g. warnings, alerts) for the mariner or operator

Harmonisation of equipment and processes

Safe, secure and **efficient** realisation of all processes inside the Global Maritime Traffic System

Is it possible to avoid such pictures ?

75 percent of accidents are induced by human errors

Around 50 percent of accidents have navigational causes

DLR


Thank you for
your attention